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The Economy and Environment Program for Southeast Asia (EEPSEA) was established in May 1993 to support training and research in environmental and resource economics across its 9 member countries: Cambodia, China, Indonesia, Laos, Malaysia, Papua New Guinea, the Philippines, Thailand, and Viet Nam. Its goal is to strengthen local capacity for the economic analysis of environmental problems so that researchers can provide sound advice to policymakers.

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The Pig Waste Question: An Assessment Of Slurry Disposal Options In Thailand

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The disposal of pig farm waste is becoming a major environmental challenge across Southeast Asia. To help find the best solution to this problem, a new EEPSEA study has looked at the situation in Thailand where the government is promoting the use of biogas conversion plants as a way forward. →

A summary of EEPSEA research report 2008-RR2, 'A cost-benefit analysis of alternative pig waste disposal methods used in Thailand' by Siriporn Kiratikarnkul: Faculty of Economics, Maejo University, 64 M.4 Sansai-Praw Rd., Nong-harn Sub-district, San-sai District, Chiangmai, Thailand 50290. Tel: 66 538 73000 ext 80, Fax: 66 538 73154, email: kiratikrankuls@gmail.com

"If the necessary investment is made ...

The study finds that, as it is currently implemented, biogas conversion actually provides fewer benefits than many of the other waste management solutions that are being used. However the report also finds that, if the necessary investment was made to allow farmers to use biogas to produce electricity and sell this to the national grid, then biogas conversion would become a good option.

The study, which was conducted by Siriporn Kiratikarnkul from Thailand, recommends that the Thai government should provide technical and financial support to encourage pig farmers to install biogas systems and help them generate electricity and sell it. It highlights the fact that there is a pressing need to support and promote this renewable energy source, which would benefit pig farmers, the environment and the economy in general.

The Pig Waste Challenge

Pig production in Thailand increased by 3.5% per annum between 1992 and 2005 and an estimated 10 million pigs are produced each year. Pig farming is carried out in all twelve livestock regions of the country. In eight of these regions it remains mostly small-scale and is conducted on mixed farms using traditional methods. However in the Central Region of Thailand (especially in the vicinity of Bangkok) and in three other regions, pig farming has become more intensive in nature. In these regions, environmental pollution caused by the waste from pig farms is now becoming a serious problem.

Five different options for pig waste disposal are currently implemented in intensive pig farms in Thailand. The first of these is the conversion of pig waste into biogas. A second option involves using pig waste as fish food in a mixed livestock and aquaculture approach. The third option is to dry the pig waste and sell it as organic fertilizer. The fourth method is simply to dump the waste into a deep pond. Finally, some farmers use a combination of the biogas, fish feed and organic fertilizer approaches.

Is Biogas Best?

Two types of biogas system are installed in pig farms in Thailand; the concrete dome type and the covered lagoon type. These options have been available for some time and farmers are currently being encouraged to adopt them by the Thai Government through a series of capital subsidy grants. Farmers who choose to invest in this technology are also given concessional rates on loans. In all, the Thai government spent 5,100 million baht between 1990 and 2000 to subsidize Thai pig farmers and help them install biogas conversion plants. Despite this, the programme had only limited success and the uptake rate of this waste disposal option has not been as high as expected. Currently, about 30.31% of pig farmers use this method to dispose of pig waste. The

Summary of the sensitivity analysis (best case–worst case) of the five pig waste disposal methods (Unit: baht per tonne)

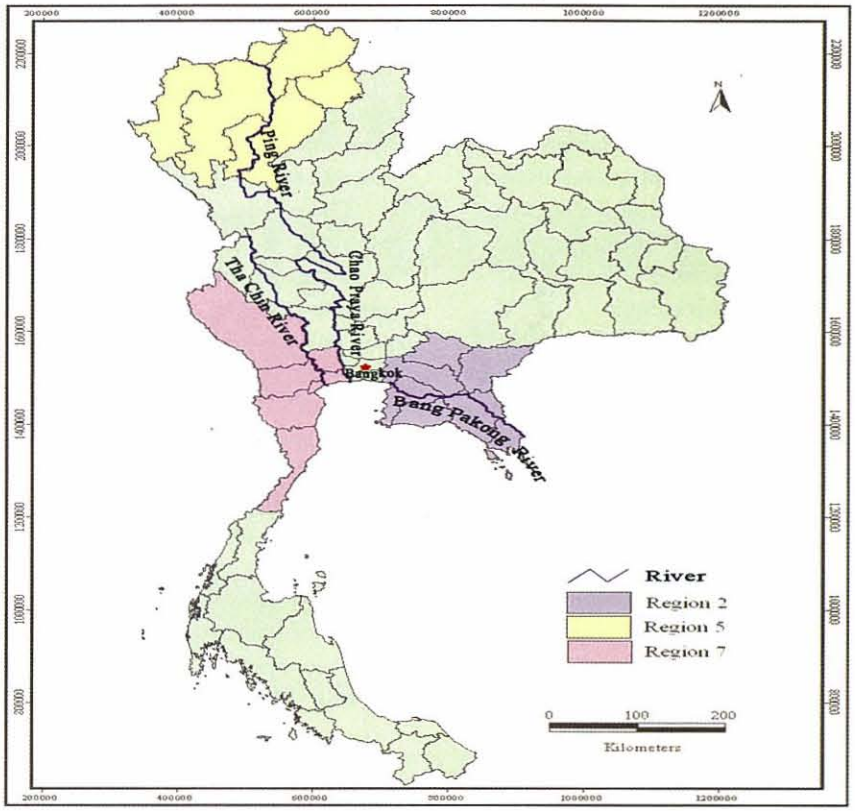
CASE	COST-BENEFIT ANALYSIS											
	Fertilizer		Fish feed		Biogas				Deep pond		Mixed	
					Concrete dome		Covered lagoon					
	Social	Private	Social	Private	Social	Private	Social	Private	Social	Private	Social	Private
Base case	**197**	**217**	**358**	**357**	**125**	**130**	**144**	**143**	**(19)**	**(9)**	**146**	**149**
BEST CASE SCENARIOS												
SALE OF ELECTRICITY TO EGAT	197	217	358	357	755	760	682	681	(19)	(9)	583	586
INDIRECT BENEFITS FR EVAPORATION SYSTEM	197	217	358	357	193	198	192	191	(19)	(9)	210	213
BENEFITS UP BY 20%	243	263	448	447	156	161	177	176	(19)	(9)	180	183
WORST CASE SCENARIOS												
NO SUBSIDY	197	217	358	357	125	125	144	143	(19)	(9)	146	146
COST UP BY 20% AND INTEREST UP BY 3%	195	215	345	343	124	127	143	141	(19)	(10)	144	145
BENEFITS DOWN BY 20%	151	171	268	267	95	100	111	110	(19)	(9)	111	114
INTEREST UP BY 3%	197	217	358	356	125	128	144	141	(19)	(9)	146	147
O & M COSTS AND RENT UP BY 20%	195	215	342	341	124	128	143	142	(20)	(11)	143	145

Note: Figures are in net present values

then biogas would be a good option."

estimated total amount of waste disposed by biogas is about 436.8 million tonnes per year (637,738 tonnes by concrete dome and 465,720 tonnes by covered lagoon).

Given this situation, Kiratikarnkul set out to discover which waste disposal option is best for Thailand's pig farmers. She aimed to see how well biogas production compares with the other waste management options and to find out why farmers choose alternative methods to dispose of the pig waste from their farms. To make her assessment, she undertook a cost-benefit analysis of the five main methods of waste disposal on pig farms. To get a complete picture, she looked at both the costs and benefits of the various systems to society as a whole and also at their financial impact on farmers.



The three main rivers in the three main livestock regions of Thailand

Investigating Intensive Pig Farming

Kiratikarnkul's study was limited to the three most productive and most intensive pig farming areas in Thailand: regions 2, 5 and 7. These regions are located in the central and northern parts of the country. She analysed only the two most productive provinces of each of these three regions, Chachoengsao and Chonburi in Region 2, Chiangmai and Chiangrai in Region 5, Nakhonpathom and Ratchaburi in Region 7. The number of the pigs in these regions represents about 58% of the total number of pigs in the whole country.

Two hundred and eighty seven farms were interviewed to get the necessary information for the study. Only large and medium scale pig farms were analysed. To assess the costs of each waste management option, four types of data were collected: 1) The initial cost of installing plant and equipment; 2) Operational costs such as equipment and labour costs, electricity and other recurrent costs and interest; 3) Mitigation costs. For example, the cost of chemicals used to treat the waste in order to reduce odour, control pH levels and prevent infestation by noxious insects, and; 4) The opportunity cost of land used (e.g. rent) and other private costs such as fines and compensation payments.

Data on the benefits associated with each disposal method were also collected. Each waste disposal option produces a potentially marketable product. Biogas can be used to provide electricity and heat. There is a ready market for organic fertilizer which may also be used on the farmer's own land. And, if waste is used as fish feed, then this assists in the production of catfish. These can be sold or used to feed a farmer's family and workers.

Costs And Benefits

The results of the study show that the fish feed and fertilizer alternatives provide large social and financial benefits to farmers. These alternatives require low initial investment and, because they are both relatively simple technologies, have low management costs. In comparison, the biogas covered lagoon and biogas concrete dome alternatives have large social benefits but low financial benefits to farmers. In terms of the

financial benefits and costs faced by farmers, the fish feed alternative method provides the highest net cash benefits. These amount to 357 baht per tonne of pig waste. In comparison, concrete dome biogas plants provide only 130 baht per tonne of pig waste. The covered lagoon biogas plants provide 143 baht per tonne of pig waste. The poor financial returns provided by the biogas alternative go a long way to explaining why farmers have been reluctant to adopt this technology.

One of the key findings of the study is that very few farms sell the excess electricity produced from biogas to the grid. Mostly, farmers use this renewable energy on their own farm. Because of this not all of the biogas produced is used. In all, less than 1% of biogas is used for domestic heating and cooling and about 17% is used to generate electricity for domestic use. So around 80% of biogas is wasted and released into the atmosphere, simply because the farmers are unable to utilise it.

How To Make Biogas An Attractive Option

Kiratikarnkul next set out to find out what could be done to induce farmers (who are currently using cheaper, but more environmentally polluting technologies) to switch to biogas production. She carried out a sensitivity analysis to assess the impact of various policy scenarios and, in particular, to see what would happen if farmers were able to utilize the biogas that is currently lost to the atmosphere by using it to generate electricity for sale to the national grid.

The results show that, particularly in large pig farms, the use of biogas converters to generate electricity for sale would be a very beneficial waste management option; both in terms of its environmental impact and in terms of the financial returns it would provide farmers. In fact this approach would provide the best returns of all current waste treatment options: 760 and 681 baht per tonne of pig waste respectively for the concrete dome and covered lagoon alternatives.

A 'Green' Energy Source From Waste

Overall it is clear that medium and large-scale pig farms can produce large amounts of biogas and that this potentially valuable source of renewable energy should be utilised. The National Energy Policy Office (NEPO) wants biogas to be one of the renewable energy sources that Thailand can substitute for imported fuel. However at present, as shown by this study, the biogas resource is simply being wasted.

If it could be fully utilised, biogas has the potential to increase the profitability and productivity of pig farms, while at the same time contributing positively to the economic situation in Thailand. Indeed, at present, pig farms in Thailand produce over 302 million m3 of biogas per year, which could be used to generate 363 mega watts of power per year.

To help pig farmers choose the most appropriate pollution control technology, the government should implement policies that encourage medium and large pig farms to produce biogas. It should also help them to use the biogas they produce to generate electricity for sale to the national grid. To do this, the government will have to provide both technical and financial support. However, this investment will be very worthwhile, as it will benefit bothThai farmers, the country's economy, and its environment.

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